Why Recycling Some Materials Reduces GHG Emissions More Than Source Reduction

We have developed emission factors for source reduction, recycling, composting, landfilling, and combustion. In the case of source reduction, we developed two sets of factors, one for source reduction that replaces the current mix of virgin and recycled inputs and one for source reduction that displaces 100 percent virgin inputs. In general, WARM users tend to use the source reduction emission factor for the current mix of virgin and recycled inputs.

For some materials (aluminum corrugated cardboard, newspaper, dimensional lumber, and medium-density fiberboard), the greenhouse gas (GHG) benefits of recycling are greater than source reduction for the current mix. This is because recycling is assumed to displace 100 percent virgin inputs, whereas source reduction is assumed to displace some recycled and some virgin inputs. The following equations show how the energy-related GHG benefits for the recycling and source reduction emission factors are calculated:

Recycling: (emissions for 100 % virgin inputs – emissions for 100 % recycled inputs) x recycling loss rate

Source Reduction: (emissions for 100 % virgin inputs x % virgin inputs in current mix) + (emissions for 100 % recycled inputs x % recycled inputs in current mix)

Therefore, depending on (1) the energy and fuel mix required to manufacture the material from virgin versus recycled inputs, (2) the recycling loss rate, and (3) the percent virgin materials in the current mix, the energy-related GHG savings from recycling may be greater than the total energy savings from source reduction. This is most likely to be the case when there is a large difference in emissions between the virgin and recycled processes, and where the current manufacturing mix includes a significant proportion of recycled inputs.

This methodology assumes the following: (1) in the recycling scenario, the demand for products is constant, and therefore, at the margin, any additional recycling increases remanufacturing and reduces virgin production; and (2) source reduction reduces overall demand for production of a material, and the effects of this reduction are distributed to remanufacturing and virgin production in proportion to their current rate of production. These assumptions are intended to support analysis of *marginal* changes in recycling or source reduction and simplify actual conditions in that they do not account for dynamic markets or supply and demand price effects.

When comparing the recycling emission factors to the source reduction factors *assuming 100 percent virgin inputs*, one can see that the GHG benefits of source reduction are greater than recycling in every case except dimensional lumber and medium-density fiberboard. This result is a function of the life-cycle framework that was used to estimate forest carbon sequestration. Estimates of forest carbon sequestration consist of two parts: (1) impact on carbon in forests and (2) impact on carbon stored in products. Both source reduction and recycling result in increased forest carbon storage – both

management practices reduce the amount of carbon that is harvested to make wood products. In terms of magnitude, source reduction is slightly more beneficial. In terms of the product pool, recycling results in increased carbon storage, as recycled wood products are incorporated into new products. By definition, source reduction does not result in a new product; therefore, no carbon is added to the product pool. The net effect of these two components of the forest carbon sequestration estimates is that recycling is more beneficial from a forest carbon sequestration standpoint than source reduction.